changes in the velocity of particles of the perilymph in different parts, depending on the degree of resistance to be overcome.

There is an elaborate chapter on the calibration of the cochlea, showing the ratio of the areas of the various membranes concerned, the measurements of the cochlea at different portions of its course, and the manner in which these influence the hairlets in their bendings. In simple and compound tones, the movements of the hairlets correspond in time with the crests, crossing points and troughs of the waves. Considering the mechanism as an engine, the piston is really the basilar membrane, and the movements are communicated to the membrana tectoria, and through it to the hairlets connected with the hair-cells. At p. 153 the interesting suggestion is made that if it could be proved that a nerve current passed continuously through the points at which the tips of the hairlets impinge on the membrana tectoria, a kind of microphonic action might take place which would modify the conversion of mechanical impulses into nervous irritation—that is, the conversion of mechanical into nervous impulses.

The second part consists of an appendix, in which Prof. Keith gives an historical and critical account of the structure of the ear. The historical portion is especially valuable, showing the development of knowledge from the time of the anatomists John and Charles Bell onwards. Special mention is made of the contributions of Bowman, who was one of the pioneers in describing the structure of the spiral laminæ and basilar membrane and the so-called muscle or ligament. Then followed Corti, Kölliker, Deiters, and Henle, who all investigated Corti's organ and prepared the way for Helmholtz. That German physiologist, taking the cue from Hensen, formulated the view that the function of the organ was to convert compound into simple pendular vibrations. The organ, according to Helmholtz, was analytic in its function. Although it was difficult, almost impossible, for the anatomists, from the small dimensions of its parts, to accept this explanation, it was generally admitted by physicists, as it seemed to meet the difficulties of the case. Prof. Keith submits the matter to a rigorous analysis, and draws the conclusion that there are no anatomical structures which serve as resonators in the cochlea. Generally, he applies Sir Thomas Wrightson's explanation with some modifications and refinements, and he is unable to follow Helmholtz. In particular, he attaches importance to the connection between the hairs or hairlets of the cells and the tectorial membrane. Each small group of hairs, surrounded by the fibres of the membrana reticularis, fits into a depression on the under surface of the membrana tectoria. The basilar membrane, although consisting of fibres arranged in parallel lines, cannot differentiate for separate tones, as the fibres are united side by side and cemented together. It cannot, therefore, be the analytic organ, and the anatomist is obliged to pass upwards to the hairlets and the membrana tectoria.

The impression one has, after perusing this book, is that this study of the cochlea makes the organ complicated and less easy to understand. If analysis takes place in the cochlea, suitable structures must be met with there which physically would suit the purpose; if analysis does not occur in the cochlea, why should there be such differentiation of structure? In other words, how can we account for the elaboration of the basilar membrane, hair-cells, hairlets, and reticular and tectorial membranes, when a direct stimulation of nerve-endings would have served the purpose? Then the principle of resonance, in its real application, would still be serviceable, although the structures were of almost inconceivably minute size. The theory of Helmholtz, although it bristles with obvious difficulties, has at all events the merit of simplicity. We must not forget, also, that minute differences in structure may be morphological other than physiological. This, no doubt, cuts both ways, but it does away with the necessity for having a physiological explanation of every structure, however minute. The Helmholtz theory does not explain, for example, the cochlea in the bird, and it is not the last word in the discussion. It may be contended, however, that it serves a purpose that is understandable. The alternative is to relegate the whole matter to a wilderness of anatomical facts, and we may give up all attempts at explanation by the hypothesis that analysis of compound tones—in short, musical analysis—is a function of nerve-cells in the grey matter of the cerebrum, of which we know next to nothing.

Both authors deserve great credit for a valuable contribution to our knowledge of the subject. The illustrations are admirable, and there are many new sections prepared by Prof. Keith. The reasoning is lucid and suggestive.

J. G. M.

OUR BOOKSHELF.

L'Evolution des Plantes. Par Prof. N. Bernard. Préface de J. Costantin. Pp. xxxii+314. (Paris: Librairie Félix Alcan, 1916.) Price 4·55 francs.

NOËL BERNARD was elected professor of botany at Poitiers in 1908 and died, at the age of thirty-six, in 1911. Prof. Costantin, in a preface written at the request of Madame Bernard, gives an interesting account of the life and work of his old pupil. Bernard was a man of wide culture and considerable ability, who devoted most of his scientific life to the experimental investigation of the germination of orchids, with special reference to their symbiotic association with fungi. The concluding chapter of this posthumous volume is a reprint of the introduction to his important paper on "L'Evolution dans la symbiose" published in the *Annales des sciences naturelles* in 1909.

The book is characterised by conciseness and clearness, qualities which one expects in the writings of French authors. The first part treats of the general laws of evolution, the evolution of the individual soma and of sexual reproduction, the idea of species, the inheritance of characters,

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species and varieties, Mendelism, and other subjects inseparable from the main thesis. Part ii. consists of concise summaries of the morphology and reproduction of the higher plants, and in part iii. some hypotheses are briefly considered and summed up in the following words:—"Les problèmes sur l'évolution que soulève l'étude morphologique des végétaux resteraient de creuses et inutiles discussions verbales si elles ne devaient pas conduire à des expériences qui permettront sans doute un jour de comprendre cette évolution assez précisément pour la diriger."

"The Evolution of Plants" is a familiar title allowing free play to an author's imagination: to the layman it suggests a clear picture of the gradual development of plant-life from a speck of living protoplasm to an oak tree. The nearer a book approaches to this standard of precision the less value it has for the biologist. Bernard's book is not of this class; it is a serious contribution which should at least bring home to the layman not only the difficulties of the problems discussed, but also the extent of our ignorance of the lines along which the development of the plant kingdom has proceeded. A. C. S.

Ambulance de "L'Océan," La Panne. Tome i., fasc. ii. Travaux publiés sous la direction du Dr. A. Depage. Secrétaires de la Rédaction: Dr. A. P. Dustin, Dr. G. Debaisieux. Pp. 381. (Paris: Masson et Cie, 1917.)

THE editor and publishers may be congratulated on the attractive way in which this second number of the "Travaux" of the "Ambulance de 'L'Océan'" at La Panne makes its appearance. The papers are copiously illustrated with beautifully executed figures. The researches are naturally devoted to questions concerning the pathology and treatment of wounds and contain many valuable results, which do not admit of a brief account. The following may be referred to as of more general scientific interest. Depage and Maloens show that wounds naturally tend to become sterile; the process, nevertheless, may be aided by the brief action of a strong antiseptic. But prolonged action is injurious to the growing cells. The good effect of Dakin's solution is said to be due chiefly to its solvent action on exudations and dead tissue. Dustin gives a valuable and complete account of the histological changes in injured nerves. De Harven concludes that the choroid plexuses have a secretory function. Sand brings evidence to show that toxic products are produced by the disintegration of injured muscular tissue, whether due to mechanical action or to bacterial infection. Levaditi and Debrez give a detailed investigation of the flora of wounds and of the physico-pathological properties of exudations. Zunz was unable to find "acidosis" (diminution of alkaline reserve) in the blood of wounded men, unless bacterial infection or respiratory obstruction was present. Govaerts points out the importance of transfusion of blood at an early stage after hæmorrhage. Saline solutions were found useless, but the effect of the addition of gum was not tested.

LETTERS TO THE EDITOR.

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Medusoid Bells.

JUST now the sea is full of little tiny bells, and, what is more, they are *all a-ringing*. A few weeks ago I watched some of them developing. Precisely how they do so is not very easy to see, but they develop with amazing rapidity. It is hard indeed to believe that they "grow," cell by cell; rather do they seem just to "come off" the parent stock, one after another, like little curiously formed drops or droplets. They seem to me to be formed *as a whole*, and, apparently (to use Adam Sedgwick's words, written more than thirty years ago), whatever cellular elements they contain "must be regarded as a multiplication of nuclei and a specialisation of tracts and vacuoles in a continuous mass of protoplasm." If this be so, we may throw conventional embryology aside, and conceive of the little bell as being automatically conformed by some physical process akin to the many beautiful phenomena of ordinary drops. But let us pass this problem by for the moment, and merely inquire what modifications of structure would be likely to ensue if the little bell, once formed or partly formed, were to be in a state of vibration; and if at the same time its semi-fluid or colloid and very heterogeneous substance were such as to permit easy transference from place to place of its heavier or lighter particles.

Suppose the little bell to vibrate as other bells do, then its fundamental note will give us four marginal nodes and four corresponding radial nodal lines. We see the latter marked out in our medusoid in the form of four equidistant and exquisitely symmetrical "radial canals"; while at the marginal nodes there appear little aggregations, sometimes of pigment, sometimes of calcareous matter, which we call "eyespots" or "otoliths." The margin of the bell, if it be free and thin, will tend to be thrown into secondary vibrations, overtones of the fundamental note; and these, as the substance firms, are rendered visible as little rounded lobes and notches set round the bell with perfect symmetry. At the nodal points we may next anticipate that little portions or drops of quasi-superfluous fluid might accumulate, and these would gradually elongate into streamers or "liquid jets," and would vary in form, remaining single or becoming branched, remaining smooth or becoming annulated or beaded, according to the surface-tensions between their substance and the surrounding medium. In any case, they would agree in number and position with the nodes, and where these were numerous and of successive orders, so also would the tentacles tend to correspond in order and magnitude. In short, several of the most important and most conspicuous features of the little "bell" would follow from the simple hypothesis of its intrinsic vibration. Fitzgerald and others have suggested that we may, in like manner, ascribe to vibration the minute and exquisite patterns of many diatoms; Dendy and Nicholson have made use of the same hypothesis to explain the characteristic form of certain sponge-spicules. I have a strong idea that the principle is very far-reaching indeed, and that its bearing on morphological problems will be found to be of great importance.

Our little medusoid is but a single instance, a single type, out of very many. All through the Cœlenterata, in polypes and corals of all sorts, we are confronted

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